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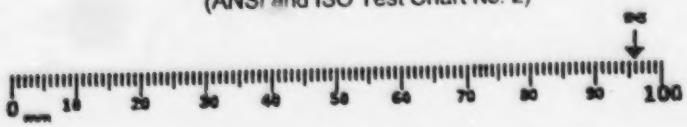

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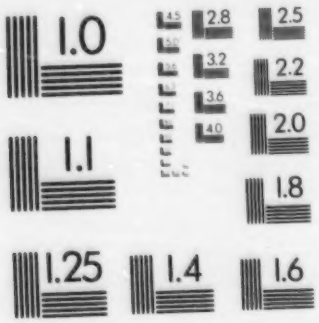

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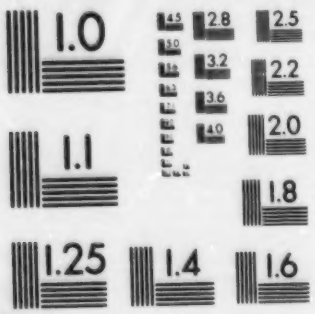

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DEPARTMENT OF NATIONAL DEFENCE
CANADA

OPERATIONAL RESEARCH DIVISION

DIRECTORATE OF OPERATIONAL RESEARCH (JOINT & LAND)

ORD PROJECT REPORT PR 9817

QUARRÉ DE FER

ANALYSIS OF THE ACV IN WARFIGHTING TASKS

by

M.K. Ormrod

P.R.S. Bender

Maj J.J.L.C. Noël de Tilly

DECEMBER 1998

OTTAWA, CANADA

National Defence Défense nationale

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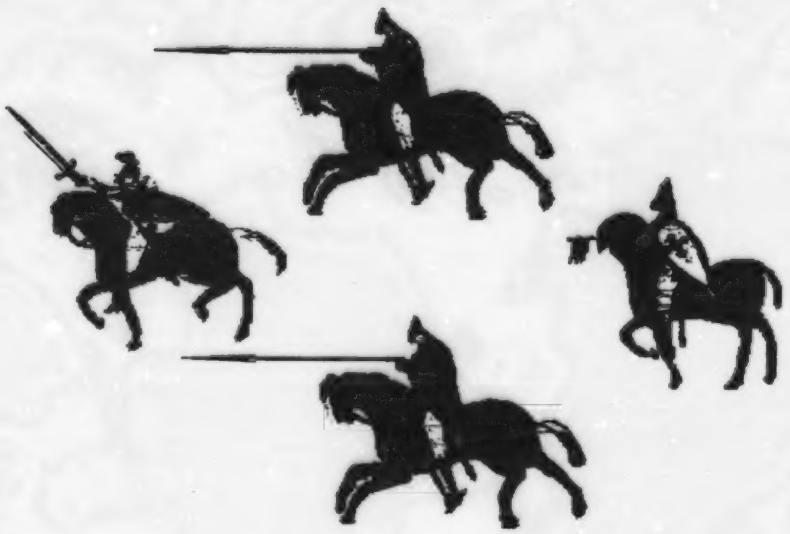

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Analysis Of The ACV In Warfighting Tasks

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OTTAWA, ONTARIO

DECEMBER 1998

ABSTRACT

This study compares the performance of an armoured combat vehicle (ACV) to a modern main battle tank (MBT) in warfighting and operations other than war (OOTW). The study found that the firepower and protection limitations of the ACV made it ineffective in offensive and intimate support roles and marginally effective in defensive and flank guard roles. The ACV could not manoeuvre in the presence of the enemy which severely restricted its tactical deployment and flexibility. For OOTW, the MBT was found to be superior in the majority of the tasks analyzed. The study recommends that the ACV not replace the MBT in armoured regiments for warfighting tasks.

RÉSUMÉ

Cette étude compare la performance d'un véhicule blindé de combat avec celle d'un char d'assaut moderne durant des opérations de guerre ainsi que durant des opérations autres que la guerre. L'étude a démontré les limites du véhicule blindé de combat en matière de puissance de tir et de protection ce qui le rendent inefficace dans des rôles offensifs ainsi que dans des rôles d'appui à l'infanterie et, le rendent d'une efficacité marginale dans des rôles défensifs et de la flanc-garde. Lors des jeux de guerre le véhicule blindé de combat n'a pas pu manoeuvré en présence de l'ennemi, ce qui, dans un contexte tactique, restreint sérieusement sa flexibilité et son déploiement. Pour ce qui est des opérations autres que la guerre, le char d'assaut s'est avéré supérieur au véhicule blindé de combat dans la majorité des tâches analysées. L'étude recommande que le véhicule blindé de combat ne remplace pas le char d'assaut au sein d'un régiment blindé lors d'opérations de guerre.

EXECUTIVE SUMMARY

In 1992, the Programme Control Board approved a two-tier approach for acquisition of direct fire support vehicles (DFSV) for the Land Force. It was directed that for operations other than war (OOTW) the Cougar (Armoured Vehicle General Purpose) would be replaced with an Armoured Combat Vehicle (ACV), a vehicle purposely designed for this role. This endeavour was listed as project L2636. As heavy armour was deemed to be essential to warfighting, it was directed that the Leopard C1 Main Battle Tank (MBT) would be upgraded in the near-term as project L2650. Project 2714 was also initiated with the objective of seeking a replacement for the MBT around the year 2010. In 1996, the Army 2000 Campaign Plan stated that the Leopard would not be replaced with a heavy tracked tank. Instead, the MBT would be replaced with "a modern, mobile, armoured direct fire support vehicle to complement the wheeled APC and COYOTE". This statement suggested that the army was considering a single DFSV that would be employed across the full spectrum of conflict. Subsequently, it was decided that a capability comparison would be required. In March 1997, the Directorate of Operation Research (Joint & Land) was tasked to conduct a study to compare the performance of an ACV to that of a modern MBT, the M1A2, in warfighting and OOTW. This report presents the results of the study.

Warfighting as the setting for the study demanded the selection of a suitable and credible role for a Canadian army formation. Consequently, the war gaming was framed within the context of Canada providing a brigade group as part of a coalition division. The scenario was that of an armoured battle group conducting a division flank guard. From this general scenario it was possible to develop smaller elements of battle, referred to as vignettes, that suit the war gaming process. These vignettes examined an armoured battle group conducting defensive and offensive operations. Analysis of war gaming results raised a number of serious concerns about the survivability of the ACV. In order to view this issue from a perspective that would focus on the survivability issue, a quick attack vignette was also included in the study.

The study clearly demonstrated the difference in the capabilities of the two vehicles used. It was also a revealing process regarding implications to doctrinal and tactical application associated with the employment of either an ACV or a tank organization. The ACV was unable to manoeuvre in the face of the enemy. When it did so it was destroyed.

Consequently it was necessary to employ ambush tactics, mainly in the defence, when the Canadian battle group was equipped with ACV. The study indicated that the use of ambush tactics still resulted in the ACV suffering 1.7 to 3.1 times the casualties compared to the MBT. The ACV was only 1/3 to 2/3 as effective as the M1A2. ACV and M1A2 comparison results are shown in the following table. What is illustrated is that the firepower and protection limitations of the ACV resulted in much heavier Canadian losses from both direct and indirect fire. The inability of the ACV to manoeuvre in contact with the enemy severely restricted the tactical flexibility and deployment of the entire Canadian force. Such limitations markedly restricted the options available to the unit commander and ultimately resulted in comparatively higher losses. As a consequence of the latter fact, the ACV battle group was considered combat ineffective following the battle in both the defence and the attack scenarios.

Summary of ACV Effectiveness Compared to the M1A2

	Ratio of ACV Losses to M1A2 Losses	Ratio of ACV LER to M1A2 LER
Defence	1.7	2/3
Attack	2.1	1/3
Quick Attack	3.1	1/3
Indirect Vulnerability	2.5	N/A

The Loss-Exchange-Ratio (LER) achieved by the ACV was disappointing, specifically when opposing the T80, which was the RED force's dominant system. This process showed that the ACV was ineffective in offensive and intimate support roles. It was marginally effective in defensive and flank protection roles. However, the ACV was wholly ineffective in defence tasks when forced to move or deploy in an effort to counter enemy manoeuvre. Enhancements to the ACV were considered as a possible means of overcoming its severe shortcomings in protection and firepower. In terms of protection, additional armour as an enhancement proved impractical. The ACV could not carry the amount of armour needed to protect it from RED force's main weapon systems. Providing a through-the-barrel-missile (TBM) significantly improved the firepower effectiveness of the ACV. Not only did the TBM improve overall firepower, but if long ranges were possible, it also

improved survivability. An additional advantage was that the TBM provided the capability for the ACV to frontally attack the T80, which 105mm kinetic energy ammunition was unable to do successfully. The TBM as an enhancement had qualified advantages, however, these were not enough to overcome the ACV's general vulnerability on the battlefield.

As a direct connection to the work done in IRON NOBLE (DGOR Project Report PR9607, which addressed the comparison of Cougar and ACV in OOTW), a comparison was made between the ACV and the M1A2 in OOTW. The research investigated comparisons in the fifteen OOTW tasks identified in IRON NOBLE. Results indicated that the ACV was considered superior in only four tasks. This outcome was specific to tasks where the ACV's weight, stealth, and speed were desirable attributes. The M1A2 was considered superior in nine of the fifteen OOTW tasks.

In summary, the study concluded that the ACV could not be used boldly and aggressively in warfighting situations. It was unable to generate the mass and shock action of a MBT-equipped armoured regiment. Equipping an armoured regiment with ACV increased the risk of failure for its commander, who was severely restricted in terms of tactical deployment and flexibility. The reality of warfighting is that one must be prepared to fight. Having made such a commitment presumes the will to win. In order to accomplish this it is essential that the most effective tools be provided to the troops tasked to do the job. Being aware of the ACV's limitations and deliberately purchasing it as an alternative to the MBT in warfighting would be morally and ethically wrong and courts defeat. Providing the proper equipment also ensures, as the research data shows, that sufficient forces will survive to carry on to further battles. As well, there is the human element. Committing troops to warfighting carries with it a massive risk. Providing them suitable equipment will reduce casualties and positively affect morale. The study data indicate that providing unsuitable equipment will result in extremely high personnel casualties and most fighting vehicles will be destroyed in an initial battle.

The study recommends the MBT not be replaced by the ACV in the armoured regiment for warfighting.

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QUARRÉ DE FER

ANALYSIS OF THE ACV IN WARFIGHTING TASKS

I. INTRODUCTION

BACKGROUND

1. In 1992, the Program Control Board approved a two-tier approach to provide direct fire support vehicles for the Land Force. It was decided that for operations other than war (OOTW) the Cougar Armoured Vehicle General Purpose would be replaced with an Armoured Combat Vehicle (ACV) designed to perform effectively in this role under project L2636. For warfighting where heavy armour was deemed to be required, it was decided that the Leopard C1 Main Battle Tank (MBT) would be upgraded in the near-term under project L2650 and replaced around the year 2010 under project L2714. In 1996, the Army 2000 Campaign Plan stated that the Leopard would not be replaced with a heavy tracked tank but by "a modern, mobile, armoured direct fire support vehicle to complement the wheeled APC and COYOTE". This statement suggested that the army was considering a single direct fire support vehicle that would be employed across the spectrum of conflict.

2. At the beginning of this study, the Statement Of Requirement for project L2636 defined the ACV as a light armoured vehicle armed with a 105mm gun. Final delivery of the vehicles was expected in the year 2006. The effectiveness of this ACV in performing OOTW tasks had been compared with Cougar in the IRON NOBLE war game series (Reference 1) conducted by the The Directorate of Operational Research (Joint & Land) (DOR(J&L)) in 1996. In order to investigate the implications of using an ACV in warfighting tasks where tanks had historically been employed, the Army Operational Research and Development Board (AORDB) tasked DOR(J&L) in March 1997 to compare the performance of an ACV to a modern MBT in warfighting and OOTW tasks.

AIM

3. To determine the effectiveness of the L2636-ACV in comparison with a modern MBT employed in warfighting and OOTW tasks in the year 2006.

SCOPE

4. The scope of this study was as follows:

   a. War gaming was used as a venue for gathering necessary data;

   b. The study employed combined arms attack and defence vignettes at battle group level;

   c. War gaming was conducted on European mixed terrain during daylight in summer weather;

   d. Applied doctrine and tactics were extracted from the references listed at the end of this report;

   e. The M1A2 was the modern MBT used in comparison to the ACV;

   f. Weapons of mass destruction were not employed in the study;

   g. Close Air Support, Electronic Warfare, counter bombardment, and logistics were not modelled as they would not have contributed directly under the gaming circumstances; and

   h. Threat forces were defined from Generic Forces circa 2006.

OBJECTIVES

5. The objectives of this study were:

   a. To provide a comparison of the ACV with the M1A2 in accomplishing warfighting tasks; and

   b. To provide a comparison of the ACV with the M1A2 in accomplishing OOTW tasks to complement the PR-9607 (IRON NOBLE) study.

II. METHODOLOGY

TOOLS

6. In order to account for the synergies present in battle group operations and to account for the large amount of data to be collected and analyzed, the two war games described below were chosen to examine the study objectives.

Computer-Assisted Board Game (CABG)

7. This war game provides a controlled environment within which the military game players get a co-ordinated overview of the scenario. Game controllers use the output from the CABG to ensure that sufficient interaction is occurring between opposing forces to generate the required data and to refine the scenarios before the start of computer play. Although the combat results from the CABG are not appropriate for quantitative analysis, observations are gathered from the game players for later qualitative analysis.

Janus

8. Janus is a computer game that simulates combat systems and the environment at the tactical level. Military players control the movement of forces and react to detections and engagements by interacting with a computer screen. The screens provide each user with a two-dimensional overhead view of the battlefield, icons that represent the forces involved, and a menu that allows the user to control the icons. Forces are defined as a group of systems. The probability of each system detecting, killing, and surviving must be accurately defined in the Janus database. Janus is a versatile tool for simulating ground combat and is capable of modelling many of the factors that influence the outcome. Examples are: day and night visibility, weather and its effects, rotary and fixed-wing aircraft, minefield employment and breaching, resupply, engineer support, and nuclear, biological and chemical (NBC) warfare.

9. Results from Janus, like any war game, are affected by the assumptions and modelling techniques used by the model's developers. For example, the user interacts with a graphical screen that provides perfect situational awareness of players' forces, therefore, it is assumed that all forces have battle management systems, and commanders have near-perfect command and control. Human factors such as training, morale, fatigue, fear, and aiming

error are not considered. Consequently, weapon systems perform at the theoretical maximum rather than at the operational norm. These and other modelling limitations do not diminish the credibility of Janus output but bear consideration when evaluating results. Janus is a powerful tool for comparing two or more systems or various tactics as the limitations of the model apply equally to all games.

10. The study was conducted as an interactive, two-sided, closed war game using Janus version 6.0 (C4) and DOR(J&L)'s unclassified database version 6.01. The scenario was gamed using 50 metre resolution digitized terrain of the HUNFELD and BAD HERSFELD areas of Germany.

ANALYSIS

11. Qualitative Results. Qualitative results are based on military Judgements and Insights (J&I). J&I are formulated through group discussions between the military game players. The results of J&I are based on careful synthesis of players' observations during war gaming combined with individual expertise and background.

12. Quantitative Results. Quantitative results are based on the statistical analysis of Janus output files. J&I are supported by quantitative analysis where possible.

MEASURES OF EFFECTIVENESS

13. The following Measures Of Effectiveness (MOE) were used to compare the ACV with the M1A2 in accomplishing warfighting tasks:

a. Mission Success. Was the battle group successful in performing its mission statement?

b. Loss Exchange Ratio. How many RED systems were killed for each BLUE system lost?

c. Residual Combat Strength. Would the battle group be capable of accepting a follow-on mission?

d. Lethality. What contribution did the ACV/M1A2 make to the mission and how successful were they at destroying RED systems?

e. Survivability. Which RED systems were destroying the ACV/M1A2 and how successful were they at surviving the attack?

f. Mobility. How did the mobility characteristics of the ACV/M1A2 affect their performance?

Mobility Analysis

14. Both CABG and JANUS are incapable of analyzing mobility issues in detail. The CABG relies on a series of movement tables which are applied by the game controllers. There is no explicit consideration of tactical mobility considerations (soil conditions, micro-terrain features, obstacle crossing, slope, road effects, etc). The movement model within JANUS takes some of these factors into consideration. JANUS considers slope, the difference in tactical mobility between tracked and wheeled vehicles, and surface culture (vegetation, roads, etc). JANUS does not represent detailed movement issues, nor does it allow the analysis of operational mobility.

SCENARIOS

15. Requirements. The two distinct warfighting tasks that can be assigned to an armoured regiment are to attack and to defend; therefore two scenarios were required to analyze the warfighting objective. OOTW scenarios were not required because the results obtained from analyzing the warfighting scenarios and those obtained from IRON NOBLE were considered sufficient to arrive at a conclusion. To reduce development time, a general scenario was selected from which a defence and attack "vignette" were developed. Vignettes take less time to game as only the forces in the vignette need to be gamed as opposed to all the forces in the larger scenario. A vignette can be thought of as a battle within a larger scale operation. Modelling vignettes increases the statistical significance of the results as one can reduce the time required to play a single game and increase the number of iterations of each game that can be played in a given time period. The general scenario helps to keep the vignettes in perspective by providing a realistic framework within which the vignettes take place.

General Scenario

16. The general scenario chosen for this study is illustrated in Figure 1. A BLUE multi-national, two-brigade division is advancing WEST along an axis. The Canadian brigade group is advancing on the left with two infantry battle groups up and one in depth. The Canadian brigade commander has task organized his armoured battle group for the mission of divisional left flank guard. He has detached one squadron from the armoured regiment and attached two infantry companies, one from the right forward battalion and one from the depth battalion. Additionally, engineers, air defence and a helicopter flight have been attached for the flank guard mission. The brigade commander has detached his recce squadron to operational command of the division as part of the divisional advance guard. The division is organized for the advance as shown in Figure 1. This division has few divisional troops and is operating without the benefit of US participation. Thus, such useful participants as armoured cavalry, attack helicopters and MLRS are not available.

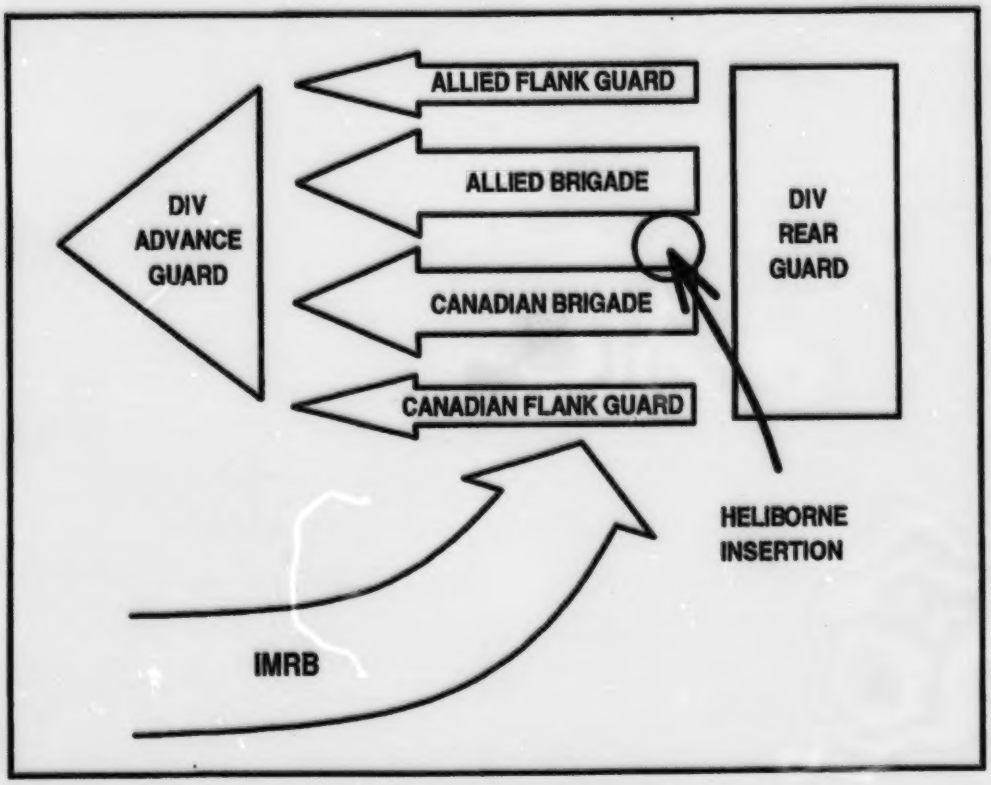


Figure 1: General Scenario Concept

17. The RED Combined Arms Army (CAA) fighting against the BLUE multi-national division is trying to halt the advance of the BLUE force so that RED can resume the offensive. By attacking BLUE simultaneously throughout the depth of his advance, RED hopes BLUE's offensive will collapse before it can launch any attacks. The CAA has landed a heliborne force into the rear of the BLUE division to disrupt the cohesion of BLUE's advance and to try and cause BLUE to overstretch his resources. At the same time, the Independent Motor Rifle Brigade (IMRB) of the CAA is manoeuvring to attack the left flank of BLUE and to link up with the heliborne force.

Defence Vignette

18. The vignette chosen to represent the ACV/M1A2 in the defence captured the battle between the forward detachment of the IMRB and the Canadian armoured battle group defending the flank of the division.

Attack Vignette

19. The attack vignette was developed from CABG play of the defence vignette. The vignette captured a battle where elements of the Canadian armoured battle group were ordered to attack elements of the forward detachment of the IMRB.

III. RESULTS

GENERAL

20. The *quantitative* results presented below are based on the average of four interactive Janus runs for each vignette and each vehicle. The Janus output files were processed off-line using a database reporting utility. The analysis will be discussed by each objective in turn beginning with a comparison of the ACV and M1A2 in warfighting using the MOE previously identified.

EXCURSIONS

21. Excursions were identified to investigate the impact of enhancing the ACV and to analyze judgements and insights that could not be validated by the gaming data. To enhance the ACV it was modelled with:

a. Additional frontal armour equal to 400mm of rolled-homogeneous-armour (RHA). This additional armour gave the ACV protection against head-on T80 engagements as long as the T80 was further than 1.0 km away. Neither the composition of the armour nor whether the ACV chassis could support it was considered; and

b. A missile capable of penetrating the frontal armour of the T80 based on the SPEAR missile (Reference 9) which is a through-the-barrel missile (TBM) with a 5.5 kilometre range.

22. To analyze the effect of these enhancements, additional games were played using the Attack Vignette where the baseline ACV was replaced by one enhanced with:

a. Additional frontal armour;

b. Four SPEAR missiles; and

c. Additional frontal armour and four SPEAR missiles.

Each of these games was played interactively three times. These excursions were played and analyzed only to obtain general indications of the effects of the enhancements.

23. In addition, a vignette was extracted from the attack scenario to analyze the concerns of the military players regarding the vulnerability of the ACV during a quick attack and to artillery fire. This vignette was analyzed using the results from 20 runs of the simulation feature of Janus (Autojan). This approach was used to overcome the limitations in analyzing indirect fire from interactive Janus runs. This vignette was simulated using the M1A2 and the ACV. Results of this vignette were analyzed and are presented in the *Quick Attack Vignette* section.

WARFIGHTING: DEFENCE

THE DEFENCE VIGNETTE

BLUE Force

24. The BLUE force consisted of the BLUE armoured battle group shown in Figure 2. The battle group had a direct support (DS) battery with the remaining three batteries of the artillery regiment in support. A general support artillery battalion was also available from divisional artillery.

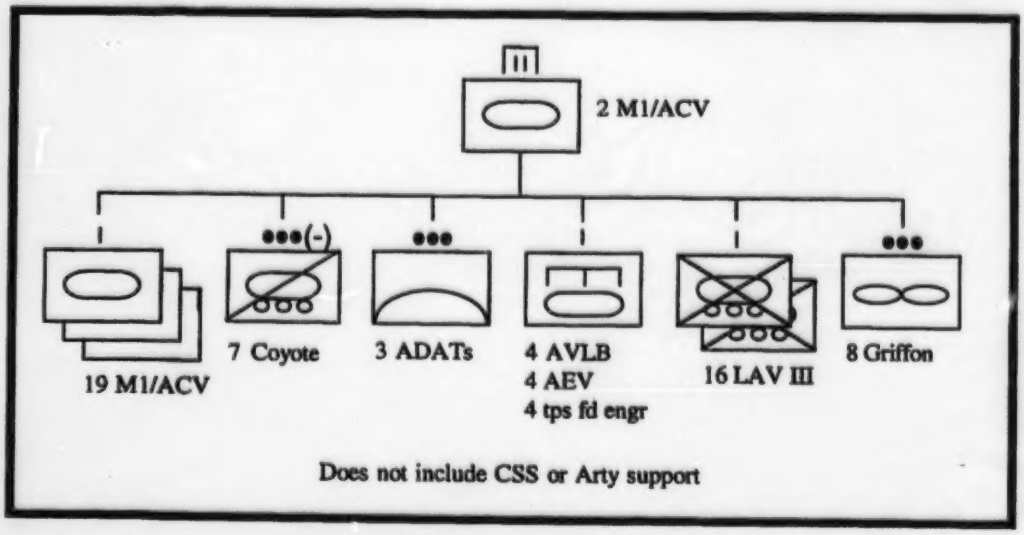


Figure 2: BLUE Armoured Battle Group

BLUE Plans

25. The armoured battle group commander has structured and organized his forces as shown in Map1 to move along three parallel routes in the following manner:

a. The SOUTHERN Route. This had the RHQ recce troop moving by patrols. The troop was insufficient to cover the 30 km flank without gaps. The helicopter flight maintained a section in the air to fill gaps in the screen.

b. The Middle Route. The commander organized three identical combat teams to move down this route which was about three to five km NORTH of the recce screen. The teams moved under battle group control to assure coverage of the flank. Each team was split in half and caterpillered from battle position to battle position along the route. The teams consisted of an armoured squadron, an infantry platoon, engineer recce and an artillery forward observer. Air defence elements also moved on this route.

c. The NORTHERN Route. This route was about three to five km NORTH of the middle route. Along this route were moving:

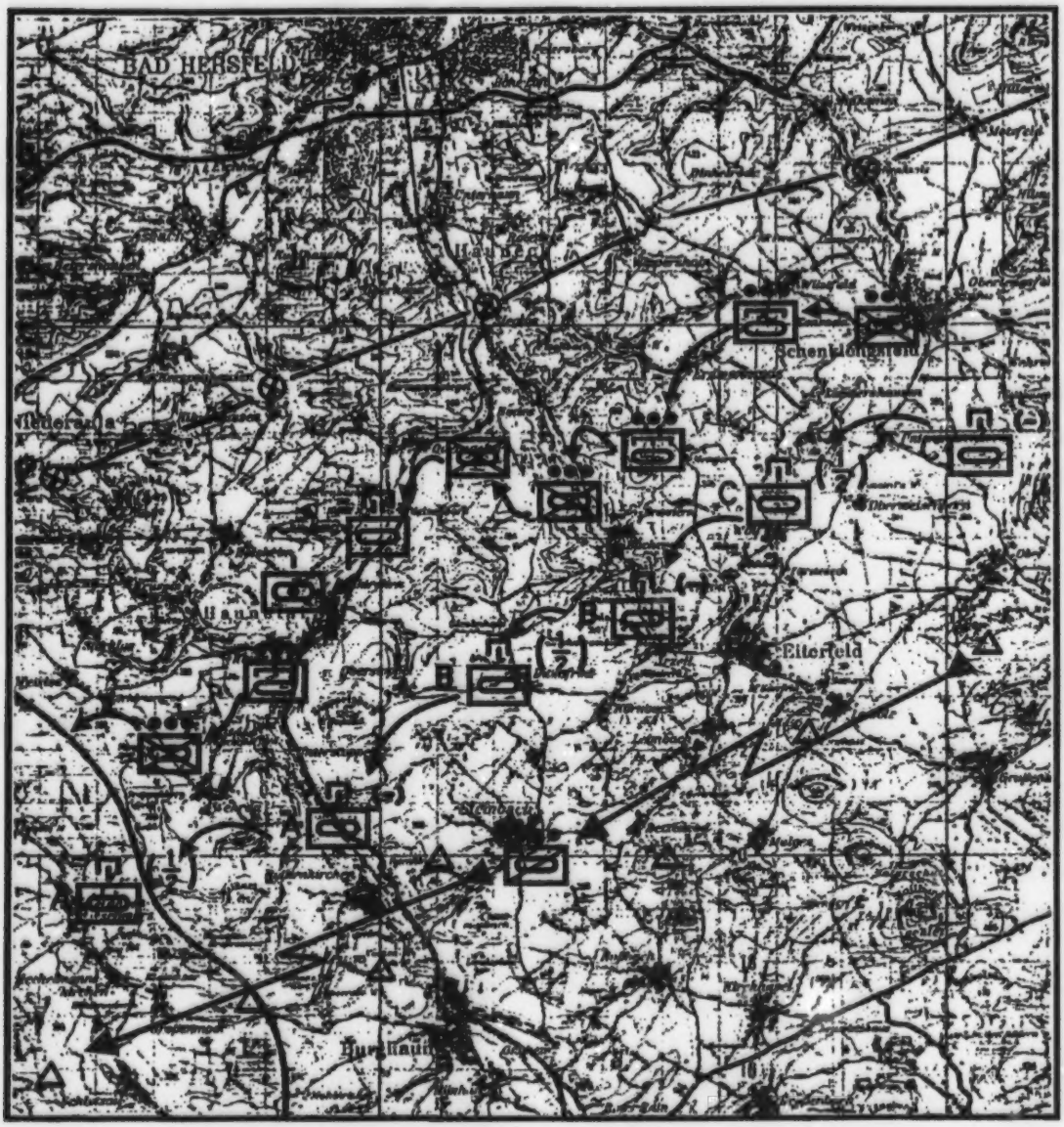
(1) an infantry company, well spread out by platoons;

(2) the armoured squadron A1 echelons, keeping station with their advancing squadrons;

(3) the engineers, moving in composite troops with armoured engineer resources;

(4) battle group HQ; and

(5) a DS artillery battery.



Map 1: Armoured Battle Group Concept of Operation

26. At game start, the BLUE division commander had just been informed that a RED heliborne force had landed in the rear of the division and was disrupting its advance. Intelligence reports also indicated that a RED force was advancing on three axes to the SOUTH of the flank guard. The orders given to the flank guard were to halt and to delay the advancing RED force while the division dealt with the heliborne force and prepared to defend against the approaching RED force.

27. The BLUE battle group commander ceased his move WEST and ordered his subordinates to occupy hasty combat team defensive positions covering the three major axes NORTH into his area. The deployment of the ACVs into these defensive positions was a significant concern for BLUE. The ACV's thin armour and inability to defeat RED's T80Us frontally meant that ACVs had to be sited to fire in short range ambush from defilade. The more capable M1A2 did not require the same tedious deployment. The battle group's recce elements took up observation positions SOUTH of the line of combat team positions. The depth (NORTHERLY) infantry company deployed in hasty platoon defensive positions on each of the three axes. Each combat team deployed its attached engineer troop to establish a crater group on the axis that it was defending. All infantry forces prepared shell scrapes while armoured fighting vehicles deployed into turret-down positions. Based on the intelligence available, and in view of his limited forces, BLUE accepted that his deployment was evenly distributed covering the three likely routes.

28. The intention was to attempt to kill the enemy recce as complete platoons to prevent information to RED about dispositions. Once the advance guard was located, BLUE planned to fix it with a combat team and destroy it by manoeuvre against its flank with, at a minimum, another combat team. The flank guard would then delay the RED main body advance back to the brigade boundary where the battalion anti-armour platoons were deployed.

RED Force

29. The RED force consisted of the forward detachment of the IMRB which was based on a reinforced tank battalion as shown below in Figure 3.

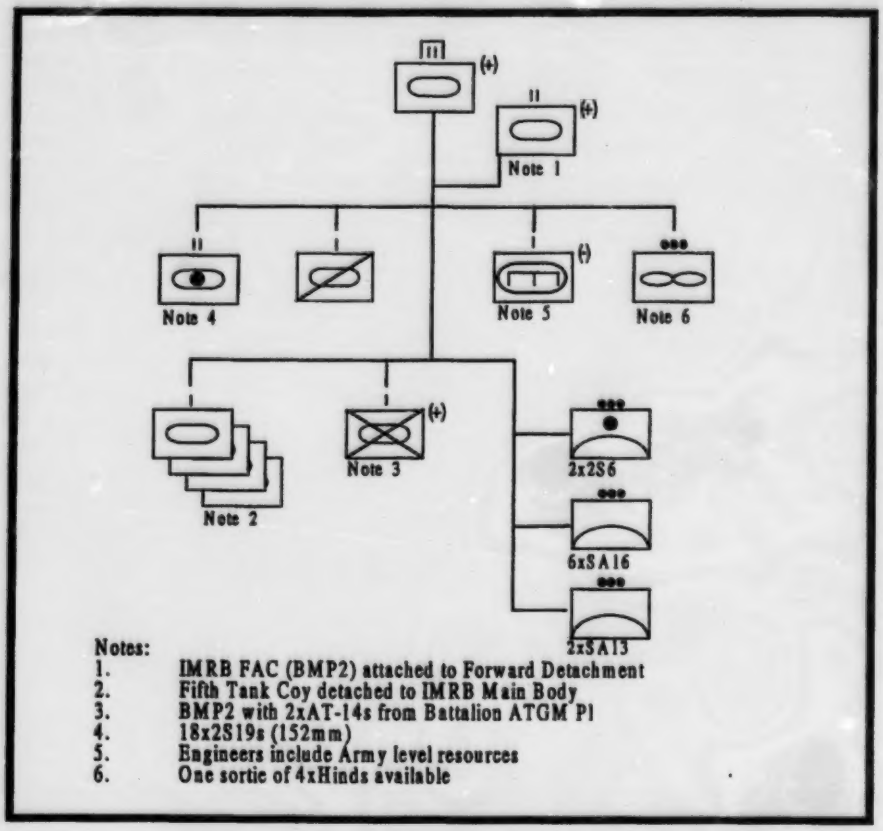
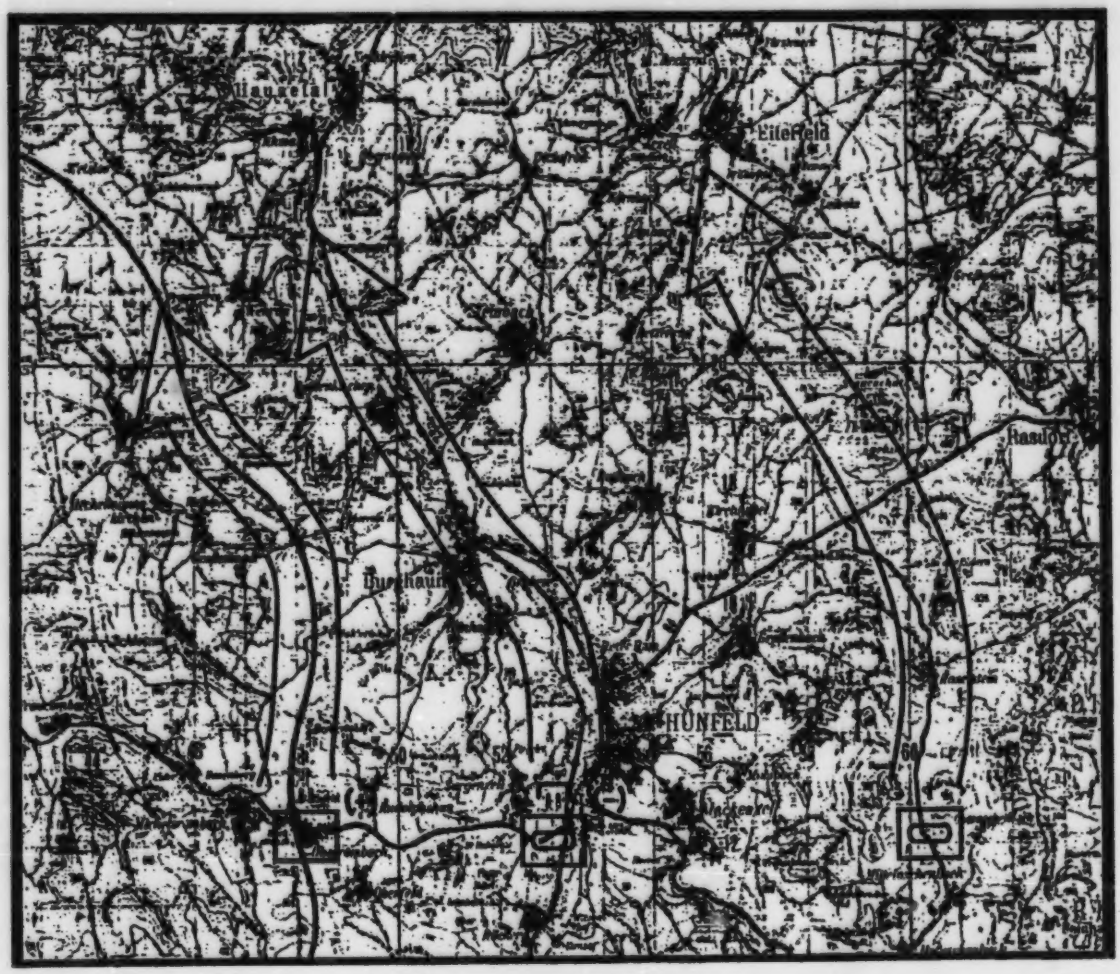


Figure 3: Structure of RED Forward Detachment

RED Plans

30. The heliborne force must link up quickly with a friendly force if it is to survive, therefore, the IMRB was ordered to move rapidly NORTH and to avoid contact as much as possible until it had linked up with the heliborne force. In favourable conditions (or out of necessity), the IMRB was expected to attack flanking or security sub-units, and disrupt or destroy BLUE forces and command, control, and communications elements. If unable to overcome BLUE, the IMRB was expected to break contact, bypass BLUE and quickly resume the link up operation.

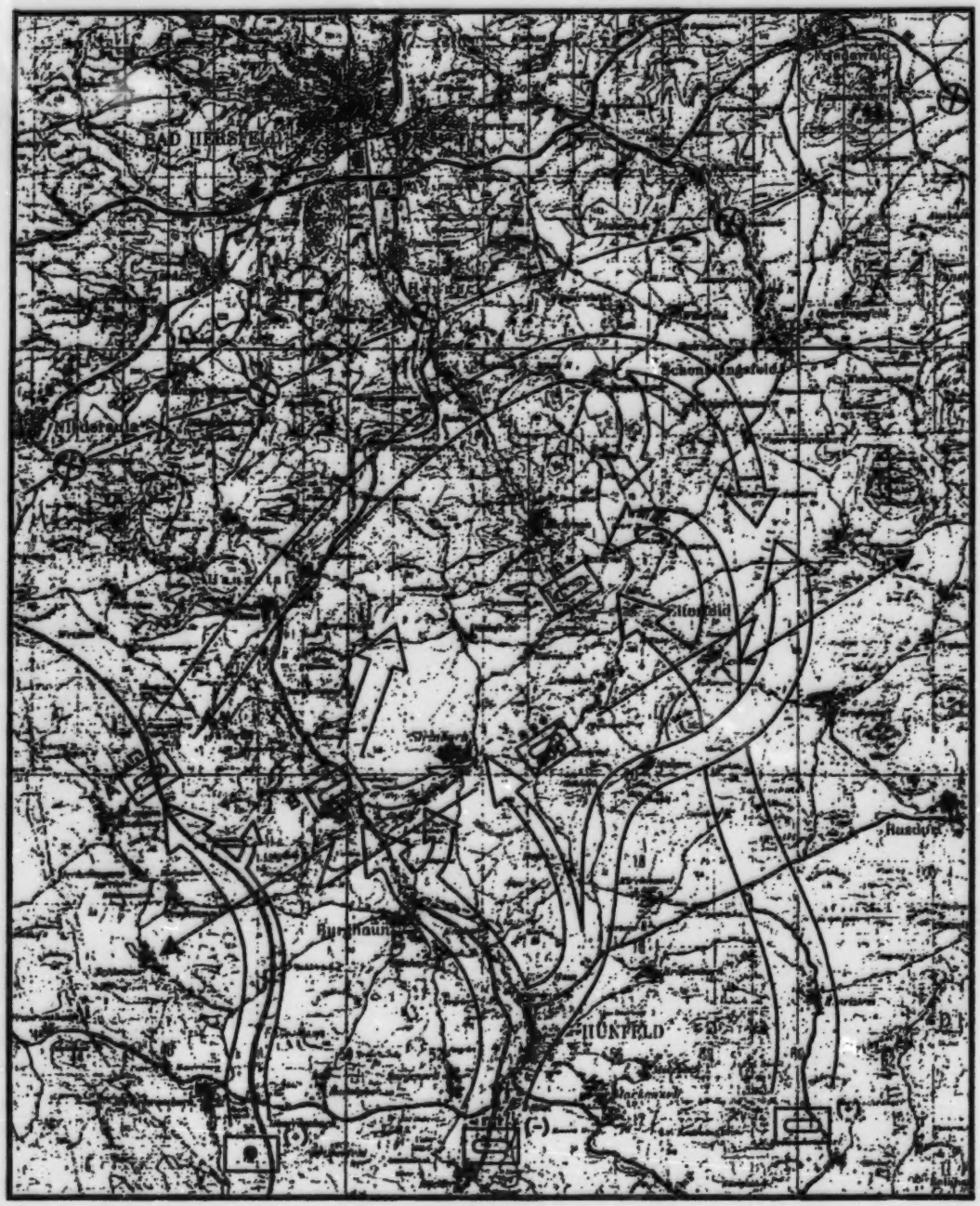
31. The forward detachment of the IMRB advanced NORTH on three axes as shown in Map 2. The IMRB Reconnaissance Company preceded the Forward Detachment on each of the three axes. The WESTERN flank axis was based on the artillery battalion, protected by a tank platoon and supported by engineer elements. EASTERN flank security was provided by a tank company supported by engineer elements. The CENTRAL axis was based on three tank companies, a motor rifle company, an artillery battery, engineer elements and a 2S6 air defence platoon. An attack helicopter platoon of four HINDS, controlled by the IMRB Forward Air Controller located with the tank battalion headquarters, was available to provide additional fire support to the Forward Detachment.



Map 2: RED Concept of Operations

GAME HISTORY

32. An illustration of a typical game is shown in Map 3.



Map 3: Defence Vignette

33. Destruction of RED's Recce. Initial contact consistently occurred with BLUE recce elements observing RED's recce. RED normally saw very little of BLUE, unless he was able to observe some vehicles that were still deploying to their positions. This lack of intelligence was a constant problem for RED. Since BLUE was able to get into hasty defensive positions first while RED was moving, RED consistently saw much less of BLUE than BLUE saw of him. BLUE sought to kill RED's recce elements quickly and completely using tank troop (+) sized ambushes by his combat teams that caught each of RED's small recce platoons all at once. This was generally successful; RED normally lost all, or nearly all, of his recce with very little hard intelligence being gained. While these losses did not cause RED to halt his advance or change his routes, RED was forced to use platoon sized Combat Recce Patrols (CRP)/Forward Patrols (FP) on each axis to provide early warning and to gather information.

34. Destruction of RED's CRP. Advancing cautiously, RED continued to press forward. BLUE sought to use the same ambush approach that had generally worked so well against RED's recce. This was easier with the M1A2. The tank's greater firepower meant that fleeting opportunities to destroy all of RED at long range could be exploited. On the WEST and CENTRE axes BLUE permitted RED's FP/CRP to advance very close to BLUE's position. Since BLUE had good concealment in static fire positions, RED was only able to avoid an ambush twice, once each on the WEST and CENTRE axes. The layout of BLUE's defence meant that RED's EASTERN flank guard FP generally got into action long after the central CRP and WEST axis FP were destroyed. In all iterations where RED did not detect BLUE early, BLUE was consistently able to destroy the central CRP and WEST axis FP in short order. A few RED vehicles occasionally survived long enough to acquire some information.

35. The destruction of the CRP on the main (centre) axis caused RED to change routes. Since the aim was to link up with the heliborne force, RED sought to fix the contacted BLUE elements with the survivors of the leading echelon and have follow-on echelons manoeuvre to the open flank to continue NORTH. The apparent strength of BLUE on the WEST and CENTRE axes led RED to move the main axis further EAST, seeking in the first instance to bypass the CENTRE BLUE position astride Highway 27 at ROTHENKIRCHEN (4919). Losses to date forced RED to use the company (-) sized Forward Security Element (FSE) to lead the way on the main axis. The surviving RED elements on the WEST axis moved EAST to support the FSE and the main body. RED's main body moved to the woods

SOUTH-EAST of BETZENROD (5420) to await events, either to reinforce the FSE or to manoeuvre further EAST to continue the link up. The EAST flank guard continued with its task and remained headed towards ARZELL (5525).

36. BLUE was able to observe RED swinging EAST. Becoming concerned about the undefended open terrain to the EAST of EITERFELD (5624) and assessing that the closer terrain on the WEST and CENTRE axes could be held with relatively small forces, BLUE decided to hold with these forces and to redeploy most of A Squadron from the WEST axis further EAST to strike at RED's main body in the area around EITERFELD. B Squadron, on the CENTRE axis, deployed elements further EAST to block the routes to HAUNETAL (4924) and to assist C Squadron at ARZELL.

37. Destruction of FSE. In the majority of iterations, where he had not seen BLUE's redeployment, RED moved his FSE EAST of Highway 27 on a route believed to be concealed from BLUE. In these iterations, the FSE advanced on STEINBACH (5220) supported by a tank troop in the woods above BETZENROD. Although achieving some minor success in some iterations, the FSE was consistently destroyed by the BLUE's B and C Squadrons located in the area of Highway 27/ROTHENKIRCHEN and ARZELL respectively. This caused RED to fix BLUE with his in-contact forces and manoeuvre even further EAST.

38. Depending on what enemy forces had been observed at ARZELL, RED decided to advance on either the route running NORTH from ARZELL or the valley EAST of EITERFELD, in both cases using the EAST flank guard as the new FSE and then following up with the main body. In both options, the WEST axis force would be ordered to swing EAST, using any surviving tanks to provide a WEST flank guard.

39. Destruction of the EAST Flank Guard. When the route NORTH of ARZELL was chosen as RED's new main axis, the EAST flank guard would launch a quick attack against the hill features either side of the town. None of these attacks, some of which were supported by HIND attack helicopters and a battery of howitzers, was successful. This loss led RED to manoeuvre into the valley EAST of EITERFELD.

40. Destruction of the RED Battalion (-). The preceding series of battles led consistently to RED's remaining forces, a tank heavy battalion (-) preceded by at least a platoon sized security element, advancing NORTH in the valley EAST of EITERFELD. RED sought to

pass through the gap near the hamlet of WOLF (5726) and then get back to the CENTRE axis via the secondary roads at ERDMANNRODE (5529) or BUCHENAU (5426). This force was supported by HIND attack helicopters, if available. By the time RED was in position, BLUE had at least a tank/ACV squadron (-) deployed in the rolling ground NORTH-EAST of WOLF.

41. When equipped with M1A2s, BLUE was also able to launch counter attacks against the BETZENROD wood feature to disrupt RED's main body and to seek to disrupt RED's advance. Such aggressive, offensive action was not possible with the lightly armoured ACV.

42. A Squadron, in the valley EAST of EITERFELD, permitted RED to close on WOLF and then carried out blocking and/or counter-attack operations, supported by C Squadron at ARZELL. Elements of B Squadron, on the CENTRE axis, supported this effort, if not otherwise engaged. The result was low-level battles where opposing forces became intermixed and combat vehicles made use of the terrain to defeat or outflank the enemy. RED sought to fix contacted BLUE forces while manoeuvring to the open flank. However, RED suffered heavy losses to the seldom-detected BLUE forces. The rolling nature of the terrain meant that small forces could be surrounded or outflanked by enemy forces that were, in turn and unbeknownst to them, also surrounded or outflanked.

JUDGEMENTS AND INSIGHTS

General

43. Overall, the battles were dominated by BLUE's and RED's need to attack the flanks and rear of the other side's main battle tank when ACVs faced T80Us and T80Us faced M1A2s. This was due to the inability of the T80U and ACV to penetrate the frontal armour of the M1A2 and T80U respectively. Losses to both sides were heavy in most battles. RED was always destroyed as a fighting force. When equipped with the ACV, the BLUE armoured battle group suffered such heavy losses that it was no longer an effective fighting unit. None of the armoured sub-units was capable of carrying out subsequent tasks. When equipped with the M1A2, the armoured battle group had sufficient residual combat power to continue operations.

M1A2

44. The baseline M1A2 tank was considered to be the dominant and most successful BLUE weapon system. Its heavy armour and more powerful gun allowed BLUE to use it much more aggressively to set up favourable situations and gave BLUE greater flexibility to react to unforeseen events. It was able to withstand significant artillery fire and could be used aggressively in all phases of the defence. It could take on and defeat the T80U in a head-to-head firefight and could withstand the direct fire of most RED systems. It easily defended the position.

ACV

45. The shortcomings of the ACV severely limited the tactical flexibility of the BLUE force and created serious deployment problems for defensive operations. Against a modern RED force, normal defensive deployment methods were considered inappropriate. They would most likely have to be abandoned in favour of a tactic such as an ambush that would minimize the firepower and protection limitations of the ACV and allow it to fire from a prepared, concealed position at the flank or rear of the enemy at close range. This tactic would substantially increase the risk of casualties and mission failure because RED would have to be permitted to advance closer to BLUE positions with a greater concentration of force. For success, the ACVs would also have to remain undetected until RED was in the killing zone. Long range attrition would be limited to TUA, ADATS, and artillery resources only.

46. Using a flanking ambush tactic and firing from defilade, the ACV was successful at destroying RED and in particular the T80U. However, once detected, superior RED firepower and greater stand-off range combined with the lack of armour protection made the ACV extremely vulnerable to both direct and indirect fire from any range and aspect. It could not manoeuvre in the presence of the enemy, and therefore it had little capability to counter-attack or perform a blocking manoeuvre. It was destroyed quickly when it attempted to break contact and withdraw to a new battle position. Similarly, the ACV was able to move rapidly on roads to new deployment areas to counter enemy manoeuvre, but it was destroyed quickly in meeting engagements unless prepared or enfilade ambush positions were available. The ACV force took substantially more losses than the M1A2 force and was considered combat ineffective following the battle. The ACV was able to defend the position but it was ineffective when forced to redeploy or move to counter RED manoeuvre.

Noteworthy Comments

47. The following associated judgements and insights merit comment.

a. ADATS was a very effective and lethal anti-armour system when so employed. It was the only weapon that could out-range the RED anti-armour systems except for the ACV's 5.5 km TBM system. It was very vulnerable to direct and indirect fire.

b. The LAV III proved effective against helicopters and BMP2s, permitting the ACV/M1A2s to concentrate on RED's main battle tanks, theT80Us.

c. The Griffon observation helicopter appeared ineffective in the reconnaissance role. Despite being modelled with modern, useful sensors, the helicopter was readily detected and destroyed by generic RED non-air defence direct fire.

d. The BMP 2 equipped with a long range missile (AT14) was a serious threat to BLUE forces including the M1A2.

e. BLUE's digitized Situational Awareness / Battle Management System was considered vital for the ACV to carry out ambush tactics.

ANALYSIS

Mission Success

48. In this analysis, mission success was judged by considering the following issues.

a. Mission accomplishment judged by whether BLUE decided to pull out or if RED decided to break off the attack and wait for reinforcements.

b. Mission duration measured by the time elapsed before BLUE decides to pull out or RED decides to break off.

49. Mission Accomplishment. The ACV and M1 battle groups were both successful at forcing RED to break off the attack in all runs.

50. Mission Duration. In the defence, the average duration for the ACV vignette was 26 minutes longer than the M1 vignette (205 versus 179 minutes). The ACV had to let RED approach much closer before opening fire. The more aggressive nature of the M1 defence reduced the combat effectiveness of RED to such a point that the RED commander was forced to break off sooner.

Loss Exchange Ratio (LER)

51. LER provides an overall measure of the effectiveness of a force because it accounts for both the losses and kills of a force. LER indicates the number of RED systems killed per BLUE loss. The higher the LER, the more favourable it is for BLUE. For example, if BLUE lost two systems and RED lost eight systems, BLUE would have an LER of four.

52. In order to focus on the main objective, which is to compare the M1 and ACV, analysis of RED and BLUE losses were limited to those systems which were considered high-value or "key". Key systems were chosen based on their contribution to the total kills by the force. For example, if the BMP was responsible for 25% of the kills achieved by RED it would be considered a key system, whereas if the BMP was only responsible for 2% of RED kills, it would not be considered a key system. For RED, the key systems were the T80 and the BMP. The key systems for BLUE were the ACV/M1A2, ADATS, and the LAV III.

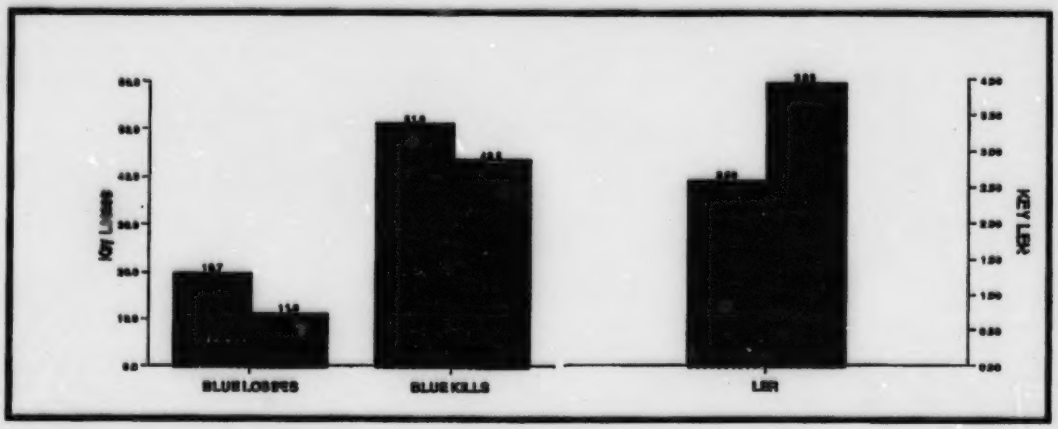


Figure 4: Loss Exchange Ratio (LER) in the Defence Vignette

53. The LER for the ACV and M1A2 battle groups are summarized in Figure 4. The results indicate that the ACV battle group took 1.8 times the losses (19.7 vs 11.0) and achieved an LER that was only 2/3 that of the M1A2 battle group (2.6 vs 4.0). The ACV battle group killed 1.2 times as many key RED systems as the M1A2 battle group because of the tactic that allowed RED to have a higher concentration of forces close to BLUE battle positions.

Residual Combat Strength

54. The ACV battle group lost 20% of its key systems while the M1A2 battle group lost 11%. Considering just the ACV or M1A2, the ACV battle group lost 15.3 of 59 ACVs (26%) compared to the M1A2 battle group which only lost 9 M1A2s (15%).

Lethality

55. Figure 5 shows the contribution of BLUE systems to key RED losses. The results indicate that the ACV and M1A2 are the dominant BLUE systems. The ACV contributed 43.7 of the 51 key RED system kills (85.6%) while the M1A2 was responsible for 33.3 of the 43.5 kills (76.4%).

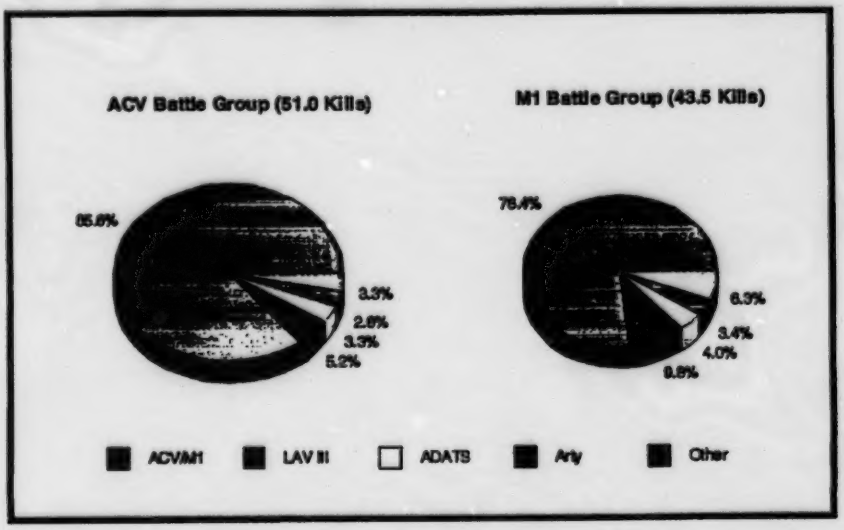


Figure 5: Contribution of BLUE Systems to Key RED Losses in the Defence Vignette

56. Breaking the ACV and M1A2 kills into T80 and BMP kills respectively results in Table 1 where lethality is defined as the number of kills divided by the number of shots. As expected, both the 105mm and 120mm guns were effective at destroying light armoured vehicles such as the BMP. The ACV killed more BMPs and had a slightly higher lethality than the M1A2 (58% vs 53%) because the RED force was in greater concentration and closer range. In spite of the difference in penetration capability of the 105mm and 120mm gun against the T80, the ACV achieved a closer than expected lethality (45% vs 51%). The ACV was almost as successful as the M1A2 against the T80 by engaging it at closer range (1.24 vs 1.73km) and by taking proportionally more flank shots (79% vs 53%) where the difference between the guns was not as significant.

Table 1

ACV/M1A2 Lethality in the Defence Vignette

	T-80			BMP		
	KILLS	LETHALITY	RANGE (KM)	KILLS	LETHALITY	RANGE (KM)
ACV	30.3	45%	1.24	13.3	58%	1.42
M1A2	22.8	51%	1.73	10.5	53%	1.50

Survivability

57. Figure 6 shows the contribution of RED systems to ACV/M1A2 losses. The higher vulnerability of the ACV, in particular to the 125mm of the T80, resulted in 1.7 times the losses of ACVs as compared to M1A2 losses (15.3 vs 9.0). The T80 was the major threat on the battlefield contributing to 11.7 of the ACV losses (76%) and 5 of the M1A2 losses (56%). The contribution of artillery and BMP kills of the M1A2 are much higher than the contribution to ACV kills because of the difference in tactics being employed. The M1A2 was used aggressively which exposed it to more direct and indirect fire. Analysis of vulnerability to indirect fire could not be assessed because of the way artillery fire is modelled in Janus. Analysis of the vulnerability to indirect fire is covered in the Quick Attack Vignette section where a fixed RED fire plan was used. Further analysis of direct fire vulnerability will focus on the T80 as no other system contributed more than an average of one kill per game and it is in the battle against the T80 where the difference between the ACV and M1A2 was most apparent.

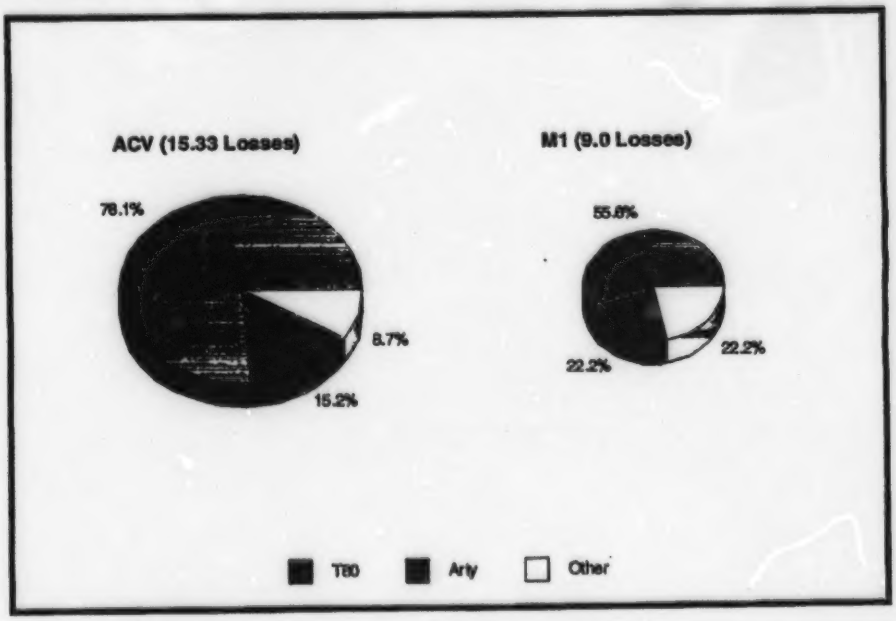


Figure 6: Contribution of RED Systems to ACV/M1A2 Losses in the Defence Vignette

58. Analysis of survivability against the T80 is summarized in Figure 7. The overall survivability of the ACV to the T80 was not as good as that of the M1A2 (65% vs 76%) because the M1A2 had much greater armour protection. The ACV survived because it was almost always in defilade when engaged by the T80 (88% of engagements) where it achieved a survivability of 71%. The M1A2 was rarely engaged in defilade (11% of engagements) where it achieved a survivability of 89%. When exposed, the ACV was much more vulnerable to the T80 achieving only a 17% survivability compared to 74% for the M1A2.

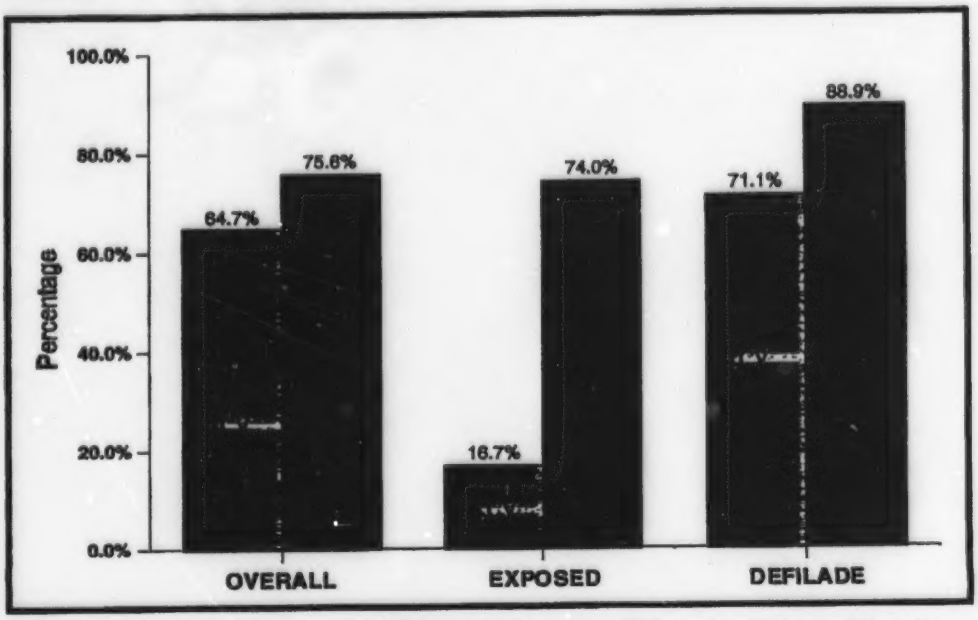


Figure 7: Survivability of ACV/M1A2 against the T80 in the Defence Vignette

SUMMARY

59. Standard defensive deployment and doctrine were found to be inappropriate for the ACV forcing the BLUE commander to adopt a much riskier tactic that minimized the firepower and protection limitations of the ACV. The ACV could not manoeuvre in the presence of the enemy, and exposed ACVs were extremely vulnerable. If the ACV remained undetected it was very effective at destroying RED by using a flanking ambush tactic and firing from defilade. The ACV battle group was successful at defending the position but suffered 1.8 times the losses and achieved only 2/3 the LER of the M1A2 battle group. Unlike the M1A2, the ACV battle group was considered combat ineffective after the battle. The ACV was able to defend the position but it was ineffective when forced to redeploy or move to counter RED manoeuvre whereas the M1A2 easily defended the position.

WARFIGHTING: ATTACK

THE ATTACK VIGNETTE

60. The Attack Vignette was developed with the Defence Vignette as its start point. Once the Defence Vignette was finalized during the CABG phase, the RED and BLUE situations and intentions were considered to identify a BLUE Attack Vignette. The relevant forces were identified on the CABG game board and their locations and strengths were recorded and then loaded into Janus as the Attack Vignette. Map 4 which illustrates a typical game of the attack vignette can also be used to identify the forces involved and their starting locations.

BLUE Force

61. BLUE had three significant groupings at game start. These were: A Squadron (-) which was moving from WEST to EAST behind BLUE's front line to take up positions EAST of EITERFELD, B Squadron (-) which had nine M1A2s/ACVs deployed in the WEST in some woods blocking the roads NORTH to HAUNETAL and the C Squadron combat team complete which was still deployed around ARZELL.

BLUE Plans

62. BLUE intended to attack immediately in the WEST against the weak RED elements SOUTH of B Squadron and let RED advance further NORTH on the EAST flank. Once RED's forces in the EAST had suffered further attrition, BLUE intended to launch a counter attack against them.

RED Force

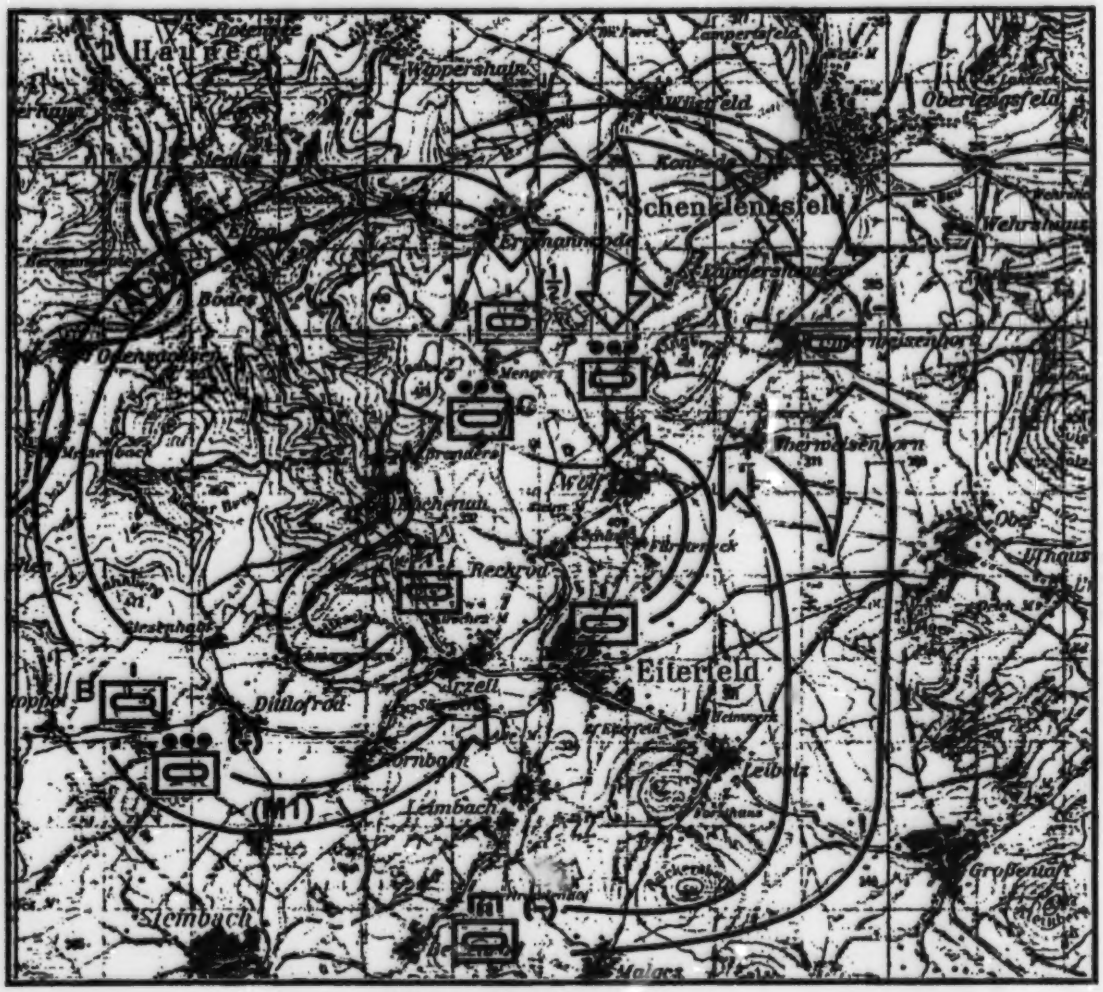
63. RED's forces were deployed in three significant groupings as well. These were: a platoon (-) of T80Us in a wood NORTH of STEINBACH, the entire EAST flank guard of tank company (+) strength in EITERFELD and the main body of a reinforced tank battalion (-) deployed in the BETZENROD woods. One motor rifle platoon of the main body had been detached to the tank company in EITERFELD.

RED Plans

64. RED intended to hold in the WEST, attack ARZELL in the CENTRE with the company in EITERFELD and then exploit with the main body, either by following up a successful attack on ARZELL or by manoeuvring further EAST in the valley EAST of EITERFELD. RED placed a FASCAM minefield WEST of ARZELL to isolate the main body's effort from B Squadron.

GAME HISTORY

65. Map 4 illustrates a typical game of the Attack Vignette.



Map 4: Attack Vignette

66. RED Attack on ARZELL. RED, supported by HIND attack helicopters and a battalion of artillery, never succeeded with this attack. The tank and motor rifle platoons sent to attack ARZELL from the NORTH were always halted passing through the WOLF Gap, despite the efforts of the two tank platoons left in EITERFELD to act as a firebase. The remnants of RED's EAST flank company were then used to support the manoeuvre of the main body into the valley EAST of EITERFELD. Typically, RED left one tank platoon in EITERFELD to hold the BLUE force in ARZELL while the other platoon would be sent NORTH EAST of EITERFELD to act as a forward patrol for the main body.

67. Battle On WEST Flank. BLUE tried to destroy the RED tank platoon (-) located NORTH of STEINBACH by attacking with his B Squadron (-). BLUE quickly learned that, despite having a four-to-one advantage over RED, such an attack was unsuccessful when carried out with ACVs. Losses as high as seven out of nine ACVs for one T80U were encountered. This led BLUE, when equipped with ACVs, to avoid attacking this platoon (-) and to bring part of B Squadron around via covered routes to the area EAST of ARZELL to support A Squadron in its fight against the RED main body. The situation was very different when B Squadron was equipped with M1A2s. Here, BLUE was always able to launch a successful quick attack against the platoon (-). In one notable iteration, B Squadron was able to attack SOUTH and then EAST from its initial location and advance across the battlefield, attacking and overrunning/chasing away four different RED elements, in turn. In this particular iteration, BLUE was so successful that all three squadrons finished the battle advancing on a halted RED main body. The B Squadron/RED tank platoon (-) battle highlighted clearly the difference between attacking with a modern main battle tank such as the M1A2 and the ACV.

68. Destruction of RED Main Body. In all iterations RED moved his main body from its initial location into the valley EAST of EITERFELD and then sought to pass via the WOLF Gap area to regain his original main axis, Highway 27. BLUE always had a squadron (-) occupying a battle position in the area around WOLF. The results of the subsequent battle depended on whether BLUE was equipped with ACVs. When so equipped, BLUE had to lay in ambush for RED and seek to destroy him by counter attack by fire. Occasionally, BLUE would be able, or have, to manoeuvre some ACVs in RED's presence. This occurred as A, B and C Squadrons were forced to redeploy to halt RED. When RED was able to detect exposed ACVs he normally inflicted heavy losses on them.

JUDGEMENTS AND INSIGHTS

General

69. In most iterations, including all of those with ACV, RED and BLUE became involved in a close range, confused struggle. Throughout RED tried to fight his way to Highway 27 while taking heavy losses against BLUE forces that were only fleetingly seen. The presence of the EAST flank guard company elements generally gave RED a better tactical disposition than in the similar portion of the Defence Vignette, but BLUE was always too strong. In the ACV iterations, BLUE was forced to use all three squadrons just to hold RED's main body. This led to all three ACV squadrons suffering such heavy losses that they become combat ineffective. Luckily for BLUE, RED was always destroyed as a fighting force before the ACV squadrons were completely overwhelmed. In the M1A2 iterations, BLUE was more than able to hold his own and to act aggressively.

70. In general, the Judgements and Insights found in the Defence Vignette were reinforced by the experience of the Attack Vignette. Once again, it was found that:

a. ACV firepower and protection limitations restricted its tactical employment and flexibility;

b. ACV could not manoeuvre in the presence of the enemy;

c. ACV could redeploy quickly on roads;

d. ACV casualties were much higher than those of M1; and

e. ACV force was considered combat ineffective after the battle.

71. The Armoured Battle Group equipped with ACV suffered excessively high casualties. Consequently, the question arose as to the appropriateness of this organization for warfighting tasks. There is no doubt that operational necessity might dictate that ACVs be used in warfighting. However, to intentionally use them in place of MBTs, knowing the ACV shortcomings, would undoubtedly raise morale and motivation problems in the armoured unit, to say nothing of the ethics of such a decision.

M1A2

72. When equipped with M1A2s, BLUE was able to be more aggressive and take the initiative. The M1A2's 120mm gun allowed BLUE to overwhelm RED in some battles by long range gun fire. In two iterations, RED suffered such one sided losses early on to 120mm gun fire that he cancelled his attack. BLUE was also able to force RED to halt his main body and then launch a three squadron counter attack. The counter attacks were successful as the M1A2 was able to withstand significant fire while advancing.

ACV

73. The counter attack phase of the defence provided the opportunity to investigate ACV offensive operations. BLUE was able to move quickly to hull down positions to block the RED advance. In most interactions, the counter attack was conducted by ACV units moving to battle positions prior to contact with the enemy. This procedure proved to be quite effective provided that the BLUE ACVs were not detected moving to their battle positions. While manoeuvring in contact, the ACV was fully exposed and very vulnerable to RED fire and as a result BLUE ACV casualties were high.

74. The ACV did not have the firepower or the protection to carry out a direct assault. It was able to delay RED successfully provided it could occupy hasty battle positions without detection and did not have to move once engaged. As a direct fire support vehicle intended to provide intimate support to infantry in the assault, the ACV was judged to be ineffective. The armour protection and firepower limitations meant that it would be unlikely to survive for long once it was exposed to anti-tank fire from the defending enemy.

ANALYSIS

Mission Success

75. Mission success will once again be evaluated by considering the same factors used in the defence vignette.

76. Mission Accomplishment. The ACV and M1A2 battle groups were both successful at forcing RED to break off the attack in all runs.

77. Mission Duration. In the attack vignette, the average duration for the ACV vignette was comparable to that of the M1A2 vignette (46 vs 49 minutes).

Loss Exchange Ratio (LER)

78. The LER for the ACV and M1 are summarized in Figure 8. The results indicate that the ACV battle group took 2.1 times the losses (18.5 vs 8.8) and achieved an LER that was only 1/3 that of the M1A2 battle group (1.0 vs 2.9). The RED losses inflicted by the ACV battle group were only 3/4 of the losses inflicted by the M1A2 battle group (19.0 vs 25.8). The 1.0 LER achieved by the ACV battle group indicated a poor exchange ratio since BLUE lost one key system for each RED system killed.

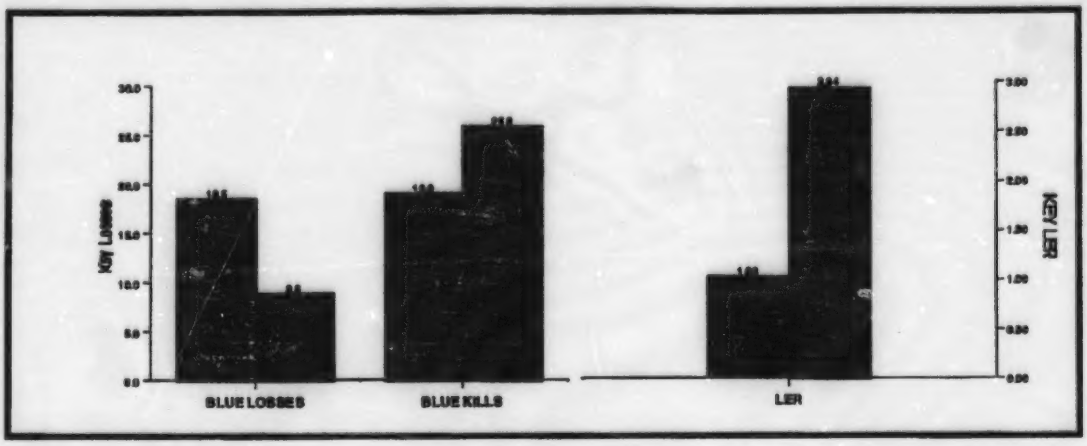


Figure 8: Loss Exchange Ratio of ACV/M1A2 Battle Groups in the Attack Vignette

Residual Combat Strength.

79. In terms of the total number of key systems committed to this vignette, the ACV battle group lost 39% of its force while the M1A2 battle group lost 19% of its strength. Considering just the ACV or M1A2, the ACV battle group lost 16.5 of 36 ACVs (46%) compared to the M1A2 battle group which only lost 7.8 of 36 M1A2s (22%).

Lethality

80. Figure 9 illustrates the distribution of RED losses by BLUE systems. The results indicate that the ACV and M1A2 are once again the dominant BLUE systems and are comparable in terms of mission contribution (87% vs 84%).

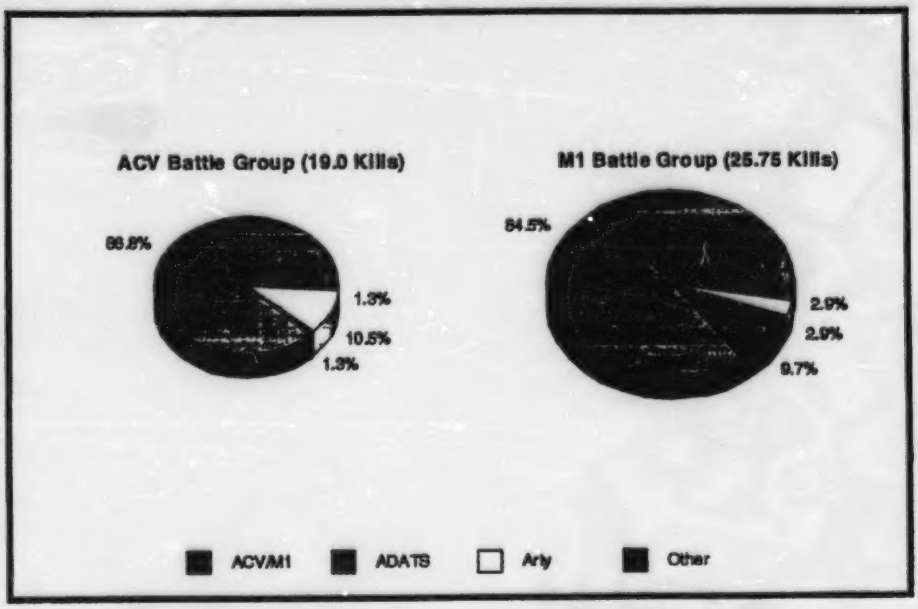


Figure 9: Contribution of BLUE Systems to Key RED Losses in the Attack Vignette

81. Breaking the ACV and M1A2 kills into T80 and BMP kills respectively results in Table 2. As in the defensive vignette, both the 105mm and 120mm guns were comparable at destroying BMPs (49% vs 51%) and showed similar lethalities against the T80 (48% vs 47%). Once again the ACV was as successful as the M1A2 against the T80 by engaging it at closer range (1.12 vs 1.30km) and by taking proportionally more flank shots (86% vs 46%) where the difference between the guns is not as significant.

Table 2
ACV/M1A2 Lethality in the Attack Vignette

	T-80			BMP		
	KILLS	LETHALITY	RANGE (KM)	KILLS	LETHALITY	RANGE (KM)
ACV	12.3	48%	1.12	4.3	49%	1.52
M1A2	17.3	47%	1.30	4.5	51%	1.53

Survivability

82. Figure 10 shows the contribution of RED systems to ACV/M1A2 losses. The higher vulnerability of the ACV, in particular to the 125mm of the T80, resulted in 2.2 times the losses of ACVs as compared to M1A2 losses (16.5 vs 7.8). The T80 was the major threat on the battlefield contributing to 89% of ACV losses and 87% of M1A2 losses. As mentioned, analysis of vulnerability to indirect fire will be discussed in a later section covering the quick-attack vignette. Further analysis of direct fire vulnerability will focus solely on the T80 as it was the dominant RED system on the battlefield, and it is in the battle against the T80 where the difference between the M1A2 and ACV was most apparent.

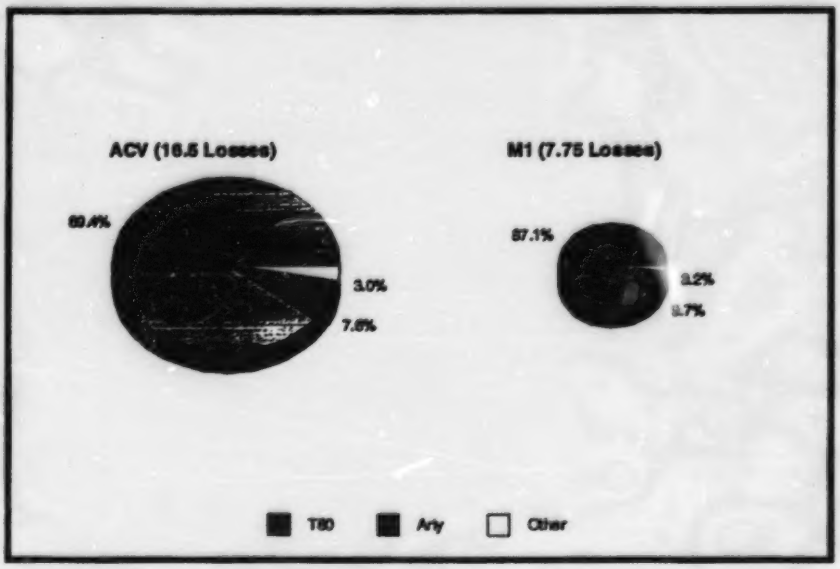


Figure 10: Contribution of RED Systems to ACV/M1A2 Losses in the Attack Vignette

83. Analysis of survivability against the T80 is summarized in Figure 11. The overall survivability of the ACV to the T80 was comparable to that of the M1A2 (59% vs 60%) despite the fact that the M1A2 had much greater armour protection. The ACV survived because it was almost always in defilade when engaged by the T80 (79% of engagements) where it achieved a survivability of 63%. The M1A2 was rarely engaged in defilade (11% of engagements) where it achieved a survivability of 89%. When exposed, the ACV was more vulnerable to the T80 achieving only a 40% survivability compared to 55% for the M1A2.

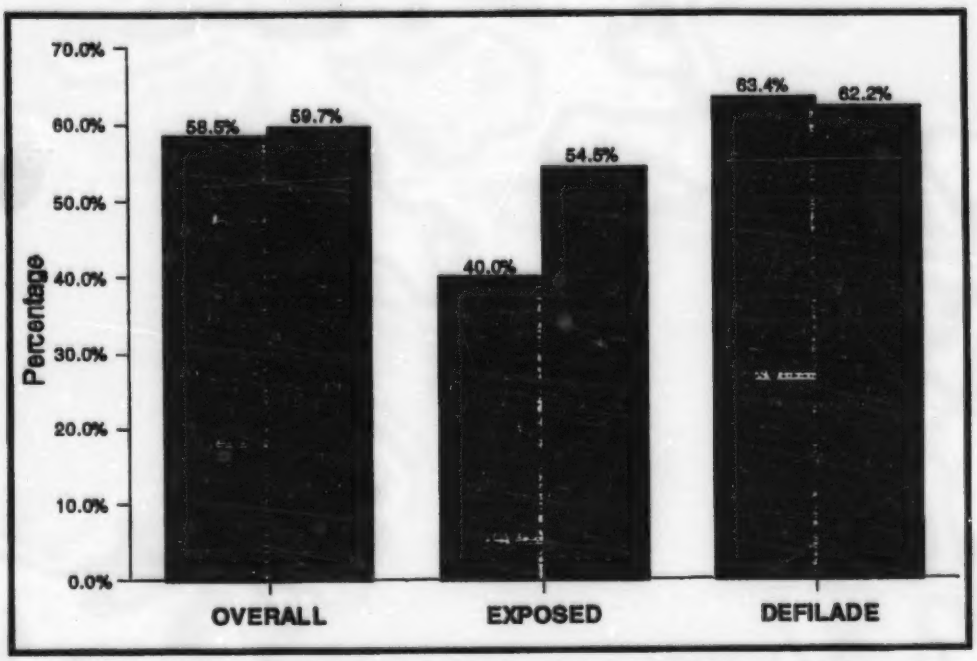


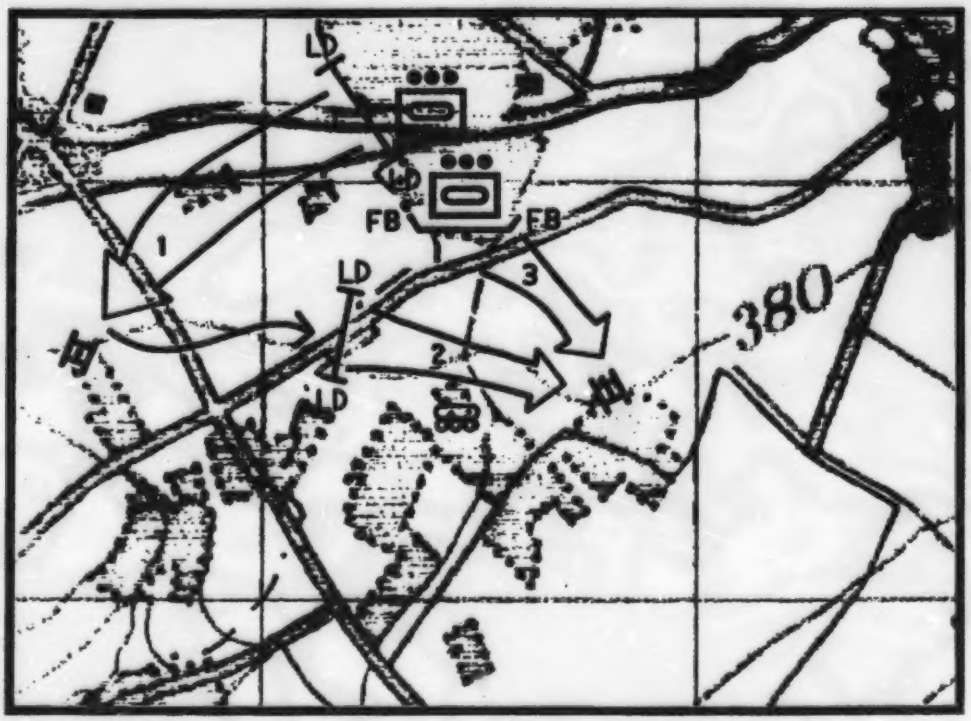
Figure 11: Survivability of ACV/M1A2 against the T80 in the Attack Vignette

EXCURSIONS

Quick Attack Vignette

84. The vignette was played with a small portion of the Attack Vignette as its start point. It focussed only on the battle between nine M1A2s/ACVs of B Squadron and a tank platoon (-) of two T80Us from the larger vignette as shown in Map 5. RED and BLUE were played having the knowledge about the enemy that they would have gained in the time prior to the small vignette starting. The size and tactical simplicity of the vignette allowed the use of the AUTOJAN function in JANUS. For this vignette, BLUE and RED were given an allocation

of artillery support and the B Squadron (-) attack against the tank platoon (-) was played interactively using M1A2s. Once a suitable interactive iteration was accomplished, it was used as the basis for 20 AUTOJAN iterations. The M1A2s were then replaced with ACVs and another 20 AUTOJAN iterations were completed. The initial start points of all forces, the artillery fire plans, the movement paths for all vehicles and the player commands to their forces remained unchanged. Only the random factors changed each iteration, allowing the gathering of statistically significant data.



Map 5: Quick Attack Vignette

85. BLUE Plan. The BLUE plan consisted of a troop attacking (see (1)) RED's western T80U after artillery preparatory fire with the second troop acting as the firebase. The assaulting troop then attacked (see (2)) the second T80U. Given that there is no opportunity in AUTOJAN iterations to change player commands the firebase followed onto the objective (see (3)). For the M1A2 iterations this third phase was normally unnecessary. However, the necessary commands had to be recorded to allow BLUE to use his full force in iterations where the assaulting troop became combat ineffective.

86. RED Plan. The terrain and RED's limited strength forced him to hold without movement. RED called in defensive artillery fire on suspected BLUE positions. RED was not able to manoeuvre his small forces. Only the T80Us that were found in the RED force in the CABG were played in this vignette. Various other systems that were not able to engage the ACV or M1A2 were not played to reduce the amount of extraneous results that could occur.

87. Judgements and Insights. During the numerous iterations, the ACV squadron (-) generally failed in its attack or succeeded with heavy losses. The M1A2 squadron (-) generally succeeded with only some losses.

88. Analysis. The LER for the ACV and M1A2 are summarized in Table 3. The results indicate that the ACV half squadron took 3.1 times the losses (5.0 vs 1.6) and achieved an LER that was only 1/3 that of the M1A2 half squadron (0.36 vs 1.08). The ACV was 2.5 times as vulnerable to indirect fire as the M1A2 (0.5 vs 0.2).

Table 3
Results of Quick Attack Vignette

	Losses to T80	Arty Losses	LER
M1	1.6	0.2	1.08
ACV	5.0	0.5	0.36

Additional Armour

89. Game History. Additional armour did not lead to any significant improvement in BLUE's results. BLUE initially tried to be more aggressive with the ACV and take on T80Us in head-to-head firefights. BLUE soon realized that the additional armour was still insufficient to allow the ACV to live long enough to kill T80Us before being killed itself. In one iteration four up-armoured ACVs engaged two T80Us head-to-head. All four ACVs were destroyed without losses to the two T80Us.

90. Analysis. The improved armour protection proved insignificant because the ACV was still 'out gunned' by the 125mm sabot or the ATGMs. The extra armour was inadequate and did not allow it to survive long enough to defeat the T80. Losses were similar to those experienced by the baseline ACV, resulting in only a marginal improvement in LER (1.1 vs 1.0).

Through-the-Barrel Missile (TBM)

91. Game History. Giving the ACV a TBM made it more effective. When able to find optimum terrain BLUE was able to overwhelm RED's lead elements with long range missile fire from carefully sited battle positions. Once BLUE ran out of TBMs or was forced to manoeuvre in the presence of the enemy he was at great risk. In one iteration, four ACVs attacked one T80U and all ACVs were destroyed.

92. Analysis. The addition of a TBM significantly improved the capability of the ACV. This enhanced ACV achieved an LER that was much better than the baseline ACV (2.0 vs 1.0) but still well below that of the M1. By using a stand-off tactic, the TBM-equipped ACV suffered roughly 1/2 the losses of the baseline ACV, however, when the ACV was exposed it was very vulnerable to both direct and indirect fire.

Additional Armour and TBM

93. Game History. In the iterations that looked at an uparmoured ACV armed with a TBM, BLUE was always successful. This was due to the destruction of RED caused by long range TBM fire into killing zones from carefully sited battle positions. RED was so overwhelmed by this fire and the lack of covered routes forward that he cancelled his attack in two iterations. There was no evidence that the additional armour improved the ACV's performance.

94. Analysis. This enhanced ACV achieved a similar performance to that of the TBM-equipped ACV. The additional armour was insufficient protection and once again proved insignificant.

SUMMARY

95. As in the Defence Vignette, the firepower and protection limitations of the ACV restricted its tactical employment and flexibility. It was forced to fire from prepared positions at the flank of the enemy tanks if it wanted to survive. The ACV cannot manoeuvre in the presence of the enemy, and exposed ACVs were very vulnerable. The ACV force was successful at forcing RED to break off the attack but suffered 2.1 times the casualties as the M1A2 force. Against the T80, the ACV force suffered 2.2 times the losses and achieved only 1/3 the LER of the M1A2 force. In a quick attack where the ACV had to be exposed, it suffered 3.1 times the casulaties and achieved only 1/3 the LER of the M1A2 force. The ACV force also suffered 2.5 times the losses to indirect fire. The M1A2 easily defeated the RED force while the ACV was considered ineffective in the offence and intimate support roles.

96. Enhancing the ACV with extra armour proved ineffective as it was still out-gunned by the 125mm of the T80. Adding a TBM capability significantly improved the LER of the ACV when the terrain permitted its use. When forced to manoeuvre, it was still very vulnerable to both direct and indirect fire.

OOTW

97. The fifteen OOTW tasks identified in IRON NOBLE were analyzed using a seminar technique that included the military players who participated in the games. The results of the discussion are summarized below.

98. ACV The ACV being lighter, stealthier, and faster on roads than an MBT was found to be better suited for:

a. Conduct convoy escort;

b. Provide mounted and dismounted OPs;

c. Provide mounted patrol; and

d. Contribute to a Rapid Reaction Force.

99. MBT. The MBT is a heavily-armoured tracked vehicle with better off-road mobility than the ACV. Its presence provided a significant level of deterrence. It was a more imposing/threatening vehicle which possessed a more powerful gun, carried more ammunition, and generated more shock action. Tanks could carry and use dozer blades, mine rollers and plows when needed. An MBT was considered more capable of adapting to escalating threat levels than an ACV. The MBT was found to be better suited for:

a. Demonstrate resolve;

b. Defend with other troops;

c. Conduct hasty defence;

d. Provide fire support to checkpoint;

e. Establish a roadblock;

f. Conduct hasty attack;

g. Provide direct fire support to infantry in the attack;

h. Reduce strongpoints, bunkers, and trenches; and

i. Secure a route.

100. Conclusions could not be drawn as to the superiority of either the ACV or the MBT in the tasks *Operations in built-up areas* and *Force security* since these tasks are mission and terrain dependent.

IV. CONCLUSIONS

COMPARISON OF ACV AND M1A2

101. This study shows that even when using an ambush tactic the ACV suffered 1.7 to 3.1 times the casualties and was only 1/3 to 2/3 as effective as the M1A2. The results of the comparison between the effectiveness of the ACV compared with the M1A2 are summarized in Table 4. This table shows that the firepower and protection limitations of the ACV resulted in much heavier losses to both direct and indirect fire. The ACV could not manoeuvre in the presence of the enemy which severely restricted its tactical flexibility and deployment. As a consequence of higher losses, the ACV battle group was considered combat ineffective following the battle in both the Defence and Attack Vignettes.

Table 4

Summary of ACV Effectiveness Compared to the M1A2

	Ratio of ACV Losses to M1A2 Losses	Ratio of ACV LER to M1A2 LER
Defence	1.7	2/3
Attack	2.1	1/3
Quick Attack	3.1	1/3
Indirect Vulnerability	2.5	

102. The LER achieved by the ACV and in particular against the dominant RED system, the T80, shows that the ACV was ineffective in offensive and intimate support roles and marginally effective in defensive and flank guard roles. The ACV was ineffective in defence tasks when forced to move and/or redeploy to counter enemy manoeuvre.

103. Enhancements. The most effective and practical enhancement to the ACV was the addition of a TBM. This enhancement allowed the ACV to engage and defeat heavy armour frontally and, where ground permitted, gave it a stand-off capability improving its survivability. In the vignette gamed for this study, the TBM-equipped ACV doubled its LER by taking half the losses of the baseline ACV. However when forced to move, the ACV remained vulnerable. Enhancing the ACV with the equivalent of an additional 400mm of RHA protection proved insignificant as it did not overcome its firepower limitations.

OOTW

104. In terms of the fifteen OOTW tasks identified in IRON NOBLE, the ACV was considered superior in only four tasks where weight, stealth, and speed were desirable attributes whereas the M1A2 was considered superior in nine tasks.

STUDY CONCLUSION

105. It was found that the ACV could not be used boldly and aggressively in combat situations, and it was unable to generate the mass and shock action of an MBT-equipped armoured regiment. The ACV-equipped armoured regiment increased the risk of failure for the BLUE commander who was severely restricted in terms of tactical deployment and flexibility. The risk of failure due to weapon system limitations and the resulting excessive casualties raised the issue of the ethical employment of the ACV in warfighting. The ACV was not considered an appropriate replacement for an MBT.

RECOMMENDATIONS

106. The study recommends that the ACV not replace the MBT in armoured regiments for warfighting tasks.

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ABBREVIATIONS AND DEFINITIONS

ACV	Armoured Combat Vehicle. The title given to the Cougar replacement vehicle in project L2636. In this study the ACV resembled a Rooikat 105, that is, an eight wheeled vehicle with a stabilized 105mm gun.
APC	Armoured Personnel Carrier. An armoured vehicle intended to provide an infantry section with transportation, armour protection and defensive firepower.
APFSDS	Armour Piercing, Fin Stabilized, Discarding Sabot. The primary anti-tank ammunition of the ACV/M1A2 and the T-80U.
AT-14	The laser beam riding anti-tank missile equipping the motor rifle battalion anti-tank platoon and carried by the BMP-2 in this study.
ATGM	Anti-tank guided missile
BMP-2	The BMP-2 used by the RED Force in this study is an infantry fighting vehicle equipped with a 30mm gun and four AT-14 missiles. It carries a crew of three and up to seven passengers.
CAA	Combined Arms Army. A RED Force organization consisting of manoeuvre divisions, support arms and services.
CABG	Computer Assisted Board Game. A war game developed by DLOR employing game tables with map enlargements, game pieces symbolising weapons or units and rule areas.
CRP	Combat reconnaissance patrol. A RED Force tactical grouping of platoon size, usually armour and infantry, intended to provide warning to a following force of enemy forces.
DGOR	Director General Operational Research
DLOR	Directorate of Land Operational Research. The 1996 reorganization of the Operational Research Division deleted this directorate and the War Games Section was assigned to DOR(J&L).
DOR(J&L)	Directorate of Operational Research(Joint & Land)
Div	Division
DS	Direct support An artillery tactical task by which an artillery unit provides forward observers, coordination, communications and advice to a supported infantry or armoured unit.
FAC	Forward air controller. A ground element responsible for controlling close air support of fixed or rotary wing aircraft.
FB	Fire base
FP	Forward patrol. A RED Force platoon moving ahead of a parent organization to provide early warning of the enemy.

H-hour	The time designated in orders for the lead elements of an attacking force to cross the LD. All timings for the attack are given as plus or minus of the H-hour.
HQ	Headquarters
Hind	The RED Force Mi24 attack helicopter.
IMRB	Independent motor rifle brigade. A RED Force all-arms group of brigade strength.
LD	Line of Departure. A control measure indicating a line on the ground which is crossed by an attacking force at H-hour, on the way to its objective.
LAV III	The Canadian armoured personnel carrier based on a MOWAG 8x8, Generation 3 chassis and armed with a stabilized 25mm gun. The LAV III has TI sensors and its mobility was assumed to be equivalent to the ACV. It has a crew of three and carries seven passengers.
MBT	Main battle tank. A fully-tracked, armoured vehicle equipped with a turret mounting a medium calibre, high velocity, quick-firing gun.
MOE	Measure of Effectiveness. A specific measurement chosen by the game scientist which supports the aim of the project.
M1A2	The current US Army MBT.
NBC	Nuclear, biological and chemical
OOTW	Operations Other Than War. All those operations envisaged for an armed force, short of those following a formal declaration of war.
OP	Observation post
OR	Operational research
ORD	Operational Research Division. The resources of DGOR.
pl	Platoon
recce	Reconnaissance
RHA	Rolled homogeneous armour. A specific type of armour steel used as a standard against which armour protection of all kinds are measured.
SPEAR	A TBM being developed by Diehl for the 105mm gun based on the Russian AT-10.
TBM	Through-the-barrel missile. An anti-tank missile launched from a tank/ACV gun.
TI	Thermal Imager.
TUA	TOW Under Armour. The Canadian long range anti-armour weapon system based on a M113A3 chassis with a two-tube armoured turret. In this study the TUA fires TOW 2B missiles and has a basic load of 12 missiles.
T-80U	The RED Force MBT in this study.
2S6	A RED Force armoured, fully-tracked, tactical air defence system equipped with twin 30mm cannon, SA-19 missiles and tracking radar.

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This study compares the performance of an armoured combat vehicle (ACV) to a modern main battle tank (MBT) in warfighting and operations other than war (OOTW). The study found that the firepower and protection limitations of the ACV made it ineffective in offensive and intimate support roles and marginally effective in defensive and flank guard roles. The ACV could not manoeuvre in the presence of the enemy which severely restricted its tactical deployment and flexibility. For OOTW, the MBT was found to be superior in the majority of the tasks analyzed. The study recommends that the ACV not replace the MBT in armoured regiments for warfighting tasks.

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ACV
MBT
Warfighting
OOTW